Geophysical Research Abstracts, Vol. 7, 10606, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10606

ANOMALOUS DEGASSING RATES FROM MT. ETNA, 2001-2005

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SO2 flux measurements have been performed regularly on Mt. Etna since 1987 using the correlation spectrometer (COSPEC, Caltabiano et al., 2004). Etna is one of the worlds most actively degassing volcanoes, accounting for ˜15% of the global flux of volcanic S into the Earth's atmosphere (Andres and Kasgnoc, 1998). For the period 1987-June 2001 the average SO2 flux was 5400 t/d with standard deviation of 1500 t/d. During the July-August 2001 eruption of Etna very high peak fluxes were recorded (maximum 20500 t/d), with an average of 7500 t/d and s.d. of 2300 t/d. At the end of the 2001 flank eruption the SO2 flux underwent a precipitous decline to an average of 950 t/d, where it remained until August 2002. An increase of ˜50% in the SO2 flux was observed prior to the 2002-2003 eruption which began on 27th October 2002 and ended on 21st January 2003. During the beginning of the eruption record high flux values were observed (up to ˜29000 t/d) with an average and s.d. of 9900 and 2700 t/d respectively for the entirety of the eruption. During the second half of the eruption, SO2 flux showed a clear trend towards low flux values which were sustained after the cessation of eruptive activity. From January 2003 to the time of writing we have observed an increasing trend in SO2 flux, with two notable excursions to higher flux values, during August 2003 and January 2005. The average post-2002/03 eruption flux has been 1900 with s.d. 500 t/d. In this period we have observed no explosive activity at the summit craters of Etna, however in September 2004 a new lava effusion began on the eastern flank of the summit area. This eruption was not associated with significant variations in SO2 flux. In January 2005 the average flux has been 3600 and s.d.  900 t/d, the highest value observed since the end of the 2001 eruption. Volcanic SO2 flux emissions are produced by the transfer to the surface of magmatic gas released through the exsolution of S during magma ascent. On persistently active volcanoes it is common to observe an excess in the volume of magma required to

produce the observed gas flux, compared with the volume of erupted scoria and lava. This observation strongly implies a process of magma circulation within the volcanic pile, in which magma may rise, degas and then sink prior to final storage probably in the form of a plutonic complex (Allard, 1997). We estimate that 26% of magma supplied to Etna was erupted for the period 1987-2004, the remainder being permanently stored endogenously. Variations in the observed gas flux are therefore attributable to variations in the magma supply rate to the shallow plumbing system of Etna. The drop in SO2 flux observed after the 2001 eruption is therefore due to either a reduction in the total magma supply rate or to a diversion of supplied magma to a storage volume, without undergoing degassing. Given the timing and violent nature of the 2001 eruption the latter is much more likely. In this work we estimate upper limits on the volume of undegassed magma that may have been stored, and discuss the implications that this has for the future eruptive activity of Etna. The recent increases in SO2 flux suggest that we are returning to the pre-2001 feeding system. This may be due to the fact that the deeper storage system has reached its capacity. We conclude that for the next few years there is a higher probability than that which existed prior to 2001 that eruptions on Etna may be fed by a voluminous body of undegassed magma.

References

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